

Missouri Chronic Wasting Disease Surveillance and Management Plan



Missouri Department of Conservation

2023 – 2027

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EXECUTIVE SUMMARY

Chronic wasting disease (CWD) remains an ever-growing threat in Missouri with the potential to result in negative impacts to deer and elk populations, economic losses, property devaluation, impacts to hunter recruitment, participation, and retention, and potential or perceived human health and safety concerns. At the same time, CWD response is growing increasingly challenging as the status of the disease on Missouri's landscape has changed considerably since its initial detection. Surveillance data strongly indicate that CWD is spreading in Missouri, with detections in twenty-two counties, widening spatial distribution in some areas, and localized areas with increasing sample prevalence. Despite these challenges, surveillance efforts thus far have resulted in detection of the disease early in new areas, and sample prevalence of the disease continues to be low. Moreover, survey data indicate that the majority of Missouri hunters support efforts to limit the disease. Taken collectively, there continues to be a substantial opportunity to successfully manage CWD and limit its effects in Missouri. Although it is appropriate to adhere to the CWD surveillance and management strategies that have proven successful in Missouri thus far, within this revision of the CWD Surveillance and Management Plan (Plan), we propose some changes in approach that follow an adaptive framework. Within this framework, we acknowledge that there are inevitable trade-offs that must be evaluated. We also acknowledge that in Missouri, as elsewhere, the disease is difficult to eliminate after becoming established, and that slowing its spread and impact is a reasonable definition of success. We also believe that success should be measured, in part, by the level of stakeholder support for CWD surveillance and management efforts.

The most significant change in the revised Plan is the recognition that a one size fits all approach to CWD management is no longer feasible. Moving forward, we will establish criteria to distinguish between a Pre-establishment CWD Infection, where there is limited disease distribution and/or low sample prevalence, and an Endemic CWD Infection, where the disease is widely established, and sample prevalence is significantly higher. Both surveillance and management decisions will be guided by these criteria, with targeted removals potentially being ceased or being applied sparingly in areas classified as having an Endemic CWD Infection, and where enhanced surveillance efforts are conducted annually only where information is most needed to guide management decisions. Results from an ongoing CWD modeling project will be used to establish these criteria. As such, we allow for the Plan to be iterative depending on results of the project. This research project will be completed by the end of 2022 and as results become available, they will be incorporated into the Plan and will be used to guide CWD surveillance and management efforts beginning in 2023. Additionally, changes to harvest regulations are being considered to increase deer harvest opportunities within the CWD Management Zone. Because CWD is at least a partially density-dependent disease, increasing harvest within the CWD Management Zone is an important disease management tool. In the future, additional changes to hunting regulations may be needed to augment the targeted removal

program or to serve as an alternative where targeted removals are no longer conducted in an area due to high sample prevalence rates and/or wide spatial distribution.

Mandatory sampling will remain an important part of CWD surveillance within the revised Plan. However, because the number of counties within the CWD Management Zone now exceeds staff capacity to conduct mandatory sampling in all counties, we present a new approach to aid in determining where this surveillance tool is best applied. A ranking tool will be developed that will consider several disease risk factors to rank counties in order of surveillance priority, thus allocating staff resources where disease spread is most likely to occur, allowing for rapid management intervention. For counties within the CWD Management Zone where mandatory sampling does not occur annually, sampling goals will be developed to detect desired levels of sample prevalence change through time. Moving forward, we will continue the annual statewide taxidermist surveillance effort, but we acknowledge critical data gaps where they exist or areas where change is needed in assessing status of the disease. As such, Wildlife Health Program staff will develop county-level sampling goals for the 2023 disease surveillance year and will work with regional staff to develop a strategy for meeting these goals.

Communicating effectively with stakeholders about CWD and our approach to CWD surveillance and management remains critically important. Communications and Science Branch staff will continue to work jointly to evaluate the most effective ways of keeping stakeholders informed about CWD and CWD management, and we propose the creation of a strategic communications and marketing plan to guide CWD communications. We will continue to prioritize communicating effectively with stakeholders at all levels and will evaluate the effectiveness of these efforts using surveys and other social science methodologies. Department staff are actively engaged in research to gain a greater understanding of barriers and motivations for stakeholder participation in CWD management efforts as well as stakeholder understanding and opinions about CWD and CWD management.

This revised Plan provides long-term strategic goals and a framework that directs surveillance and management of CWD in Missouri, but it is critical that CWD response remain sufficiently adaptive as circumstances change or new information becomes available. As such, response activities may deviate from the Plan when warranted, and the Plan will be updated when significant changes in approach are made. Although this Plan provides guidance for monitoring the distribution and prevalence of CWD and adapting management strategies to address current conditions and future developments, it is strategic in nature; a CWD Operational Plan, renewed annually, will provide specific surveillance and management directives.

INTRODUCTION

The mission of the Missouri Department of Conservation (MDC) is to protect and manage the fish, forest, and wildlife resources of the state, and to facilitate and provide opportunity for all

citizens to use, enjoy, and learn about these resources. One of MDC's top conservation goals is to manage for healthy and sustainable fish and wildlife populations. Wildlife populations are increasingly threatened by emerging diseases, and the impacts of infectious diseases are an important management consideration. Chronic wasting disease (CWD) is a fatal disease of deer, elk, and other members of the deer family and is widely recognized as one of the most challenging threats to wildlife health that we face today. Diseases like CWD not only have the potential to negatively impact wildlife populations but also people's perceptions, experiences, and behaviors related to wildlife.

Routine surveillance for CWD began in Missouri in 2002 and MDC implemented its first CWD Surveillance and Management Plan (Plan) in 2012, soon after the disease was first detected in the state. Since implementation of the Plan, MDC has been responding to CWD using an adaptive approach as status of the disease has changed through time. The Plan was updated in 2015 to reflect changes in response after the detection of CWD in additional areas of the state, new scientific advances, and identification of unaddressed or newly identified disease risk factors.

This document provides long-term strategic goals that direct surveillance and management of CWD in Missouri. The Plan provides a framework to guide CWD surveillance and management response, but it is critical that CWD response remain sufficiently adaptive as circumstances change or new information becomes available. As such, response activities may deviate from the Plan when warranted, and the Plan will be updated when significant changes in approach are necessary. Although this Plan provides guidance for monitoring the distribution and prevalence of CWD and adapting management strategies to address current conditions and future developments, a CWD Operational Plan, renewed annually, will provide specific CWD surveillance and management directives.

The epidemiology of CWD complicates disease control strategies. With its extended incubation period, capability for both direct and indirect transmission, and the lack of a reliable live animal test, eradication of an established outbreak from a free-ranging population is not likely. An important factor in influencing the success of managing CWD is the level of infection at the time of initial detection. Therefore, MDC will focus on increasing its surveillance efforts and continuing to respond rapidly to disease confirmations. It is important to recognize that even if aggressive management action is taken, there are no guarantees of disease control. If CWD increases greatly in both geographic distribution and prevalence within a CWD Management Zone or CWD Core Area, Science Branch staff will reevaluate the approaches outlined in this Plan.

At present, the best available evidence from areas where CWD is widely established indicates that in the absence of management intervention, CWD will increase in prevalence and distribution among susceptible cervid populations. Chronic wasting disease does not result in

large scale, rapid mortality. As such, the disease may be erroneously regarded as an insignificant threat to cervid populations. However, the negative impacts of CWD on free-ranging cervid populations are significant. Long-term negative population effects and an increase in clinically affected animals have been associated with CWD in other states where the disease is widespread. Specifically, in some areas with high CWD prevalence rates, deer and elk population declines have been attributed to the disease. Moreover, hunter numbers have reportedly declined in some of these areas. On a social level, CWD has the potential to adversely impact deer hunting – one of Missouri’s most important cultural traditions. The impacts to state and local economies could be significant. Finally, potential public health risks, if any, are unknown at this time and limiting the load of prions on the landscape and in the food supply have long been recommended by public health officials.

CWD-related knowledge has increased substantially over the past few decades, though many knowledge gaps remain. Fortunately, there has been a recent resurgence in research on CWD and other prion diseases. This research may lead to innovative breakthroughs on disease management. For this reason, it is important that this Plan remains flexible to adapt to changing knowledge in the field.

The following summarizes some of the key characteristics of CWD that are important to consider when creating a CWD Surveillance and Management Plan.

- CWD is a fatal, contagious, neurodegenerative disease of cervids that attacks the brain and nervous system of infected animals.
- Currently, there have been no reported cases of CWD infection in people. However, some studies suggest CWD poses a risk to certain non-human primates, raising concerns that there may also be a risk to humans. Public health officials recommend hunters in areas known to have CWD test their deer and do not consume meat from CWD-positive animals.
- CWD has an extended incubation period in infected animals (>12 months); it takes many months from the time a cervid is infected until they show clinical symptoms.
- Infectious prions are shed in urine, feces, and saliva 3-6 months after an animal becomes infected and deer are contagious long before they exhibit clinical symptoms.
- CWD can spread through direct deer-to-deer contact.
- CWD can spread indirectly through environmental contact and once shed or deposited in the environment, infectious prions remain stable for years.
- In most infected populations, adult males have a higher CWD positivity rate compared to other sex/age classes, possibly related to behavior (e.g., larger home ranges than females and higher levels of social contact with other male deer and multiple female social groups).
- Carcass parts from infected deer can spread CWD.

- Deer density likely plays some role in CWD transmission; however, interactions in and amongst social groups, even at lower densities, are likely to be an important factor affecting disease transmission.
- Following the introduction of CWD to a new area, infection rates are initially low with a slow increase in prevalence and geographic spread over time. However, without active management interventions, infection rates tend to increase and reach a point of near exponential growth, eventually resulting in high disease prevalence.
- Peer-reviewed, scientific studies show that high CWD prevalence can be associated with adverse population impacts.
- Early detection of, and response to, CWD is critical to effectively managing the disease.
 - Removing infected individuals from the population early in an outbreak offers some hope of limiting the rate of prevalence increase by reducing direct transmission.
 - In early stages of infection, limiting the amount of environmental contamination through the removal of infected individuals may offer some control in limiting disease prevalence and distribution.

MISSION OF CWD SURVEILLANCE AND MANAGEMENT IN MISSOURI

The goals, objectives, and strategies outlined below are designed to guide CWD surveillance and management within an adaptive framework over the next five years. Additionally, these goals, objectives, and strategies serve as the framework for which annual operational planning occurs. Current and future operational activities, as well as additional items for consideration, have been detailed in the following sections: Statewide CWD Surveillance and Monitoring, CWD Response, Surveillance Within the CWD Management Zone, CWD Management and Prevention, CWD Communications, CWD Research, Free-Ranging Elk in Missouri, Confined Cervids in Missouri, and Hunter Service Testing.

GOALS, OBJECTIVES, AND STRATEGIES

Goal 1. Surveillance: Detect CWD early in new locations and monitor changes in distribution where CWD is found.

- Objective 1.1: Conduct CWD surveillance annually at the statewide scale to detect the disease as early as possible in new locations.
 - Strategy 1.1.1: Prior to each CWD surveillance year (July 1 – June 30), set annual county-level sampling goals to meet desired detection precision levels.
 - Strategy 1.1.2: Work with regional staff to create strategies to meet county-level sampling goals.

- Strategy 1.1.3: Continue to partner with taxidermists throughout the state annually to obtain CWD samples through the Cooperator Sampling Program and evaluate the feasibility of partnering with additional taxidermists and meat processors in select locations to collect CWD samples where needed to meet sampling goals.
- Strategy 1.1.4: Assess the feasibility of contracting with private sector wildlife biologist and/or wildlife consulting firms to meet county-level sampling goals.
- Strategy 1.1.5: Assess the feasibility to use voluntary sampling as a successful surveillance tool.
- Strategy 1.1.6: Evaluate the feasibility of an incentive program to encourage hunters to voluntarily submit CWD samples.
- Strategy 1.1.7: Provide sick deer response guidelines to staff annually by June 15 to ensure consistency of approach in sample collection and submission.
- Objective 1.2: Maintain increased CWD surveillance intensity within the CWD Management Zone to increase likelihood of early detection in new areas.
 - Strategy 1.2.1: Continue to designate CWD Management Zone counties as those within 10 miles of a CWD-positive detection.
 - Strategy 1.2.2: Conduct mandatory sampling annually in at least a subset (highest priority) of counties within the CWD Management Zone using a ranking system to determine where sampling will occur annually.
 - Strategy 1.2.3: Use results of the CWD modeling project to develop trigger points to identify when sample prevalence and/or spatial distribution are great enough to negate conducting mandatory sampling in a county annually.
- Objective 1.3: Monitor changes in spatial distribution and sample prevalence of CWD over time.
 - Strategy 1.3.1: Establish county-based surveillance goals within the CWD Management Zone, where mandatory sampling is not conducted annually, to meet desired detection precision levels and to monitor changes in sample prevalence over time.
 - Strategy 1.3.2: Estimate sample prevalence of CWD annually in each affected county and monitor trends through time.
 - Strategy 1.3.3: Continue to monitor spatial distribution of CWD at the section level.

Goal 2. Hunter Service Testing: Maintain hunter confidence and trust by meeting hunter service testing demands and addressing real or perceived public health concerns associated with CWD.

- Objective 2.1: Offer voluntary sampling opportunities for hunters within, and outside of, the CWD Management Zone.

- Strategy 2.1.1: Assess current demand for hunter service testing and determine where deficiencies exist.
- Strategy 2.1.2: Evaluate the freezer drop-off program and determine feasibility of program expansion.
- Strategy 2.1.3: Evaluate current voluntary sampling use at MDC offices and assess the need for program expansion.
- Strategy 2.1.4: Pilot a program to provide training materials and supplies for hunters to collect and submit CWD samples.
- Objective 2.2: Continue working with select meat processors in the CWD Management Zone to collect samples as part of the Share the Harvest CWD Testing Program.
 - Strategy 2.2.1: Identify barriers, implement improvements, and possibly offer additional incentives, to encourage more participation from meat processors in this program.
 - Strategy 2.2.2: Explore possible solutions to address difficulties in donating taxidermist-bound deer to the Share the Harvest Program.
 - Strategy 2.2.3: Implement additional training for staff that interact with meat processors to ensure consistency in messaging.

Goal 3. Communication: Provide accurate and relevant information about CWD to the public, agency staff, and other stakeholders.

- Objective 3.1: Clearly and effectively communicate with stakeholders about CWD and MDC's CWD surveillance and management approach.
 - Strategy 3.1.1: Work with the CWD Communications Team to develop a strategic CWD communication plan, including future planning for marketing efforts both statewide and regionally (as needed).
 - Strategy 3.1.2: Continue working with the CWD Communications Team to implement an annual CWD communication strategy that provides relevant, accurate, and scientifically based information about CWD to the public and key stakeholders.
 - Strategy 3.1.3: Use results of the landowner CWD focus group research project to develop a communications strategy to assist with landowner communication related to targeted removals.
 - Strategy 3.1.4: Use results of CWD communications survey to help revise CWD communications strategy, including refining messages to be most effective.
 - Strategy 3.1.5: Use internal communication tools and training opportunities to ensure consistent, accurate messaging about CWD by all MDC staff.
 - Strategy 3.1.6: Work with partners to provide information about CWD at stakeholder engagement events.

- Strategy 3.1.7: Communicate results of CWD research projects to MDC staff and the public.
- Objective 3.2: Provide information about the status of CWD in Missouri and sampling efforts to date.
 - Strategy 3.2.1: Provide easy access to annual sample numbers and county-level sampling results for MDC staff and the public by developing a web-based spatial mapping tool.
 - Strategy 3.2.2: Create an annual CWD report that provides information about CWD surveillance and management efforts and current disease status and trends.
 - Strategy 3.2.3: Disseminate results of CWD surveillance and management efforts to department staff, partners, and the public in a timely manner.
 - Strategy 3.2.4: Develop metrics to evaluate the success of CWD management efforts and communicate this information to stakeholders.
- Objective 3.3: Increase promotion of voluntary CWD sampling opportunities.
 - Strategy 3.3.1: Improve web-based sampling location tools.
 - Strategy 3.3.2: Expand methods for promoting voluntary sampling opportunities.
 - Strategy 3.3.3: Work with partners to implement educational outreach programs about CWD and CWD management.

Goal 4. Management and Prevention: Apply management actions to limit the further spread of CWD where it has been detected and decrease chances of introduction into new areas.

- Objective 4.1: Implement management recommendations within the CWD Management Zone to reduce CWD transmission risk and minimize spread of the disease.
 - Strategy 4.1.1: Continue to implement a ban on feeding and placement of minerals for deer within the CWD Management Zone.
 - Strategy 4.1.2: Continue to implement carcass transportation restrictions for deer harvested in the CWD Management Zone.
 - Strategy 4.1.3: Continue to rescind the antler-point restriction for new counties that become part of the CWD Management Zone.
 - Strategy 4.1.4: Continue to liberalize antlerless harvest opportunities within the CWD Management Zone, when appropriate.
- Objective 4.2: Expand deer hunting opportunities within the CWD Management Zone where additional harvest is needed to meet disease management goals.
 - Strategy 4.2.1: Evaluate potential changes to harvest regulations within the CWD Management Zone including potential changes to season portion(s), allowed methods, bag-limits, and incentives for increased harvest.

- Strategy 4.2.2: Use results of deer hunter surveys to determine the level of support for potential changes to deer hunting regulations within the CWD Management Zone.
- Strategy 4.2.3: Evaluate potential incentives for harvest of CWD-positive deer.
- Strategy 4.2.4: Issue CWD Management Permits to qualifying landowners within CWD Core Areas.
- Strategy 4.2.5: Evaluate the efficacy of the CWD Management Permit program and modify, as necessary.
- Strategy 4.2.6: Evaluate the potential for increasing the number of processors participating in the Share the Harvest Program to provide hunters with more incentive to harvest additional deer.
- Objective 4.3: Reduce direct and indirect CWD transmission by removing deer after the end of the deer hunting season through use of targeted removals near where CWD has been detected.
 - Strategy 4.3.1: Work with landowners in CWD Core Areas on a voluntary basis to conduct post-season targeted removals.
 - Strategy 4.3.2: Use results of the CWD modeling project to help prioritize the locations at which targeted removals occurs to maximize efficiency and effectiveness.
 - Strategy 4.3.3: Use results of the CWD modeling project to identify trigger-points to guide targeted culling efforts to allocate limited resources where they are likely to be most effective.
 - Strategy 4.3.4: Use results of the CWD modeling project to evaluate the effectiveness of alternative harvest strategies to implement in areas of endemic CWD infection.
 - Strategy 4.3.5: Use results of the landowner focus group research project to evaluate potential incentives to increase landowner participation in targeted removals.
- Objective 4.4: Regulate confined cervids in a manner that minimizes the risk of disease transmission among cervids within these facilities and with free-ranging deer and elk.
 - Strategy 4.4.1: Work with the Missouri Department of Agriculture and confined cervid industry representatives to ensure compliance with the regulations established for confined cervids in Chapter 9 of The *Wildlife Code of Missouri*.
- Objective 4.5: Minimize risk of CWD spread by continuing to implement carcass transportation and disposal requirements.
 - Strategy 4.5.1: Continue assessment of hunter knowledge about carcass transportation restrictions.

- Strategy 4.5.2: Work collaboratively between Science and Protection Branches to assess compliance with carcass transportation restrictions and disposal requirements.
- Strategy 4.5.3: Complete a census of Missouri landfills and transfer stations to create a list of locations where deer butcher waste is accepted and identify critical disposal gaps.
- Strategy 4.5.4: Provide educational tools to hunters, such as field dressing and processing information, to foster adherence to carcass transportation restrictions.
- Strategy 4.5.5: Assess the need for and feasibility of establishing carcass disposal stations within CWD Management Zone counties to facilitate adherence to the carcass transportation regulations.

Goal 5. Research: Support and conduct applied research on CWD and its epidemiology to support management of the disease.

- Objective 5.1: Conduct research and monitoring efforts to better inform CWD management decisions.
 - Strategy 5.1.1: Identify research needs as they relate to CWD epidemiology and management.
 - Strategy 5.1.2: Prioritize research needs annually and actively pursue internal and external CWD research funding opportunities as appropriate.
 - Strategy 5.1.3: Continue ongoing research projects to evaluate efficacy of targeted removals and assist with future prioritization of targeted removal efforts.
- Objective 5.2: Conduct research to ensure the effectiveness of CWD communication efforts.
 - Strategy 5.2.1: Use results of the landowner focus group research project to improve understanding about the barriers and motivations of landowners to participating in the targeted removal program.

STATEWIDE CWD SURVEILLANCE AND MONITORING

Disease surveillance is the strategic sampling of a subset of a population to detect, observe, and monitor changes to infectious diseases. Early detection allows management intervention to be applied at a point when the likelihood of slowing disease growth rates and spread is most likely to be successful.

Statewide, baseline surveillance of CWD in Missouri will maximize the probability of early detection in an efficient manner. For counties in which mandatory sampling is not conducted, county-specific sampling goals will be provided in an annual CWD Operational Plan. County-specific sampling goals will be based on desired detection probabilities, regional risk factors, and other factors such as estimated deer population densities. As part of MDC's statewide CWD

surveillance efforts, sampling goals will be met through the methods listed below. Counties in or near locations where CWD has been detected will have additional surveillance criteria, and different sampling goals and methods for achieving those goals, as described in the Surveillance within the CWD Management Zone section of this Plan.

1. Continue the annual Cooperator Sampling Program

Leveraging taxidermists to collect CWD samples is an effective CWD surveillance tool because it boosts detection probability by weighting surveillance towards adult male deer, the sex-age class that typically exhibits the highest CWD prevalence rates and saves MDC staff time. Training, frequent communication, and oversight of sample and data integrity are necessary. Finally, partnerships with taxidermists allow opportunity for relationship building and outreach and education amongst a constituent group that is in frequent contact with hunters. In areas of the state where sampling goals are not being met, an attempt will be made to recruit additional taxidermists.

2. Consider expanding the Cooperator Sampling Program by recruiting meat processors where sampling gaps exist.

The Department has partnered with meat processors for CWD surveillance since 2012, first by sending staff to their businesses to collect CWD samples from deer dropped off for processing, and more recently to facilitate the Share the Harvest CWD Sampling Program within the CWD Management Zone. Significant progress has been made working with processors to assist directly with CWD surveillance efforts by asking that they collect CWD samples or deer heads. Given the high number of deer brought to these businesses and the associated workflow, especially during the peak of deer season, it has been difficult for many of these businesses to assist with CWD surveillance in the past. The Conservation Department will continue to consider recruitment of meat processors in counties where sampling goals are not being met.

3. Consider additional regionally led sampling efforts to meet surveillance goals.

In counties where the number of CWD samples collected annually is below surveillance goals, Science Branch staff will coordinate with regional staff to devise a strategy to increase sample numbers. We acknowledge that there are some areas of the state in which lower deer numbers, lower deer harvest, and other constraints will necessitate flexibility in the approach. County-specific sample size targets, and the approach for sample collection, will be first implemented during the 2023 CWD surveillance year (July 2023 – June 2024).

Although Science Branch staff will work with regional staff to determine the most feasible options for obtaining samples, possible sample sources for these regional sampling efforts could include:

- Sampling vehicle-killed deer.
- Roving sampling of hunter-harvested deer during peak deer seasons.
- Sampling deer from managed hunts.
- Sampling deer from deer hunting cooperatives.

In addition to county-specific sampling goals, MDC will continue to test sick deer across the state, prioritizing deer that show signs consistent with CWD clinical infection.

CWD RESPONSE

The following section outlines a suite of actions that may be taken in and around areas where CWD has been detected.

Designation of a CWD Management Zone

Prior to 2019, the CWD Management Zone included all counties within 25 miles of a CWD detection, and the *Wildlife Code of Missouri* still allows for the designation of any county within 25 miles of a CWD positive detection. Implementation of this regulation was modified in 2019 when the radius of designated counties was changed from 25 miles to 10 miles based on results of a five-year study conducted cooperatively by MDC and the University of Missouri which found that more than 90% of deer dispersed less than ten miles. The CWD Management Zone will continue to be designated as counties within 10 miles of any free-ranging or captive CWD detection in Missouri or neighboring states.

The CWD Management Zone serves as a defined area to:

1. Apply broad regulations designed to prevent or slow the spread of CWD.
2. Increase surveillance above baseline statewide surveillance levels to assess disease prevalence and distribution and to increase probability of detecting spread into new areas as soon as possible.

The list of counties recommended for inclusion in the CWD Management Zone is presented each spring to the Conservation Commission and upon approval is subsequently published in the Fall Deer & Turkey Hunting Regulations and Information booklet. As such, county designations to the CWD Management Zone are updated annually.

Assessing Disease Status

Given the variation in CWD distribution and sample prevalence observed across distinct disease clusters in Missouri, CWD response in Missouri has reached a phase that necessitates defining a multi-tiered approach to surveillance and management intervention. Post-season targeted removals are most effective when the number of infected deer is low and environmental contamination is limited. As disease prevalence increases, geographic spread increases, and CWD exists on the landscape for longer periods of time, the impacts of targeted removals are expected to decrease. Moreover, targeted removals may become inefficient or impossible to continue uniformly over large areas. As such, a framework will be developed to define disease status as either 1) Initial CWD Detection, 2) Pre-establishment CWD Infection, or 3) Endemic CWD Infection, and will guide surveillance and management intervention accordingly. This framework will be developed using results from an ongoing collaborative research project, which was initiated in 2021 between MDC and researchers at Emory University and the University of Montana. The primary objective of this project is to use a CWD modeling framework to help guide future targeted removal efforts (see Post-season Targeted Removals Section of the Plan for more information). Project results will also be used to set the sample prevalence threshold and distribution scale that will define disease status as Initial CWD Detection, Pre-establishment CWD Infection, or Endemic CWD Infection. Results of this research project will be available by the end of 2022. As results become available, they will be incorporated into this Plan and will be used to guide surveillance and management efforts beginning in 2023.

Initial CWD Detection

An Initial CWD Detection will be defined as an area where a single CWD positive deer is detected. If a single CWD-positive sample results in a county entering the CWD Management Zone, and no additional CWD-positives are detected within 10 miles of the county for three consecutive years, Science Branch staff will analyze surveillance history and may recommend removal of the county from the CWD Management Zone. In the event of new detections where multiple positives are found, the infection status will be categorized immediately as a Pre-establishment CWD Infection or an Endemic CWD Infection depending on sample prevalence and the spatial extent of the disease.

Pre-Establishment CWD Infection

Pre-establishment CWD infection will be defined as an area where sample CWD prevalence is low and geographic distribution limited. In a Pre-establishment Infection, direct deer-to-deer transmission is likely driving CWD growth rates more significantly than indirect environmental transmission. Therefore, targeted removals are more likely to be effective and logistically feasible where sample prevalence and geographic distribution of disease are greater. Results of

the previously mentioned CWD modeling project will be used to develop specific criteria to define this disease status designation.

Endemic CWD Infection

An Endemic CWD Infection will be defined as an area where CWD sample prevalence has increased beyond a target sample prevalence level and/or geographic spatial scale. The longer CWD persists on the landscape and the more infected deer there are, the greater role environmental transmission likely plays in spread of the disease. Observations of CWD sample prevalence in other states indicate that CWD infection rates reach an inflection point after which increases in sample prevalence are exponential. In an area with an Endemic CWD Infection, targeted removals are less likely to be effective than in areas classified as an Initial CWD Detection or a Pre-establishment CWD Infection where the geographic footprint of the disease is smaller and prevalence rate lower. As such, criteria are needed to determine when targeted removals are no longer a feasible management strategy. Results from the previously mentioned CWD modeling project will be used to define an Endemic CWD Infection and when to shift away from localized management efforts. In areas classified as having an Endemic CWD Infection, targeted removals will be ceased or will be applied in a very selective and limited manner because the success of this form of localized management likely diminishes as CWD becomes more widely established. The primary purpose of a CWD Core Area (see Designation of a CWD Core Area section) is to delineate an area to apply localized management intervention; therefore, the boundaries of a CWD Core Area may be removed and CWD Management Permits may also be discontinued in Endemic CWD Infection areas. Where possible, management intervention will shift towards harvest management at larger spatial scales (e.g., county level). Results from the ongoing CWD modeling project will be used to evaluate potential alternative harvest management strategies that could be applied in an area classified as having an Endemic CWD Infection.

SURVEILLANCE WITHIN THE CWD MANAGEMENT ZONE

Increasing surveillance in and around areas where CWD has been detected has several benefits. It allows for greater confidence in estimating disease distribution and prevalence, provides information to monitor changes over time, and increases the likelihood of detecting areas of disease spread earlier. Enhanced sampling in these areas also provides hunters with more information about disease status and the probability of harvesting a CWD-positive deer.

The primary method that MDC uses to achieve increased sampling numbers in the CWD Management Zone is mandatory sampling on opening weekend of the November portion of firearms deer season. Focusing on the two days of the hunting season when the greatest number of deer are harvested provides an efficient way to collect a high volume of samples in a short time period.

Given the number of counties in the CWD Management Zone, and the limitations of the staff resource, it is likely that mandatory sampling will only be conducted in a subset of counties within the CWD Management Zone moving forward. Recommended counties for mandatory sampling will be proposed by Science Branch staff each spring and presented to the Conservation Commission for approval with the annual Deer Regulations Packet. Annual decisions on which counties to conduct mandatory sampling in will be based on:

1. A new surveillance ranking tool, which will incorporate disease risk factors and surveillance history.
2. Targeted removal goals and priorities. One of the primary purposes of mandatory sampling is to detect new areas of spread early enough that localized management interventions, such as targeted removals, can be effective.
3. Minimum sampling needs to detect desired levels of prevalence change over time.
4. Available agency resources.

The ranking tool will incorporate key variables related to disease status and likelihood of spread, and level of confidence in previous surveillance efforts. Variables will include, but are not limited to, the number of positive detections, total years with positive detections, time since last detection, total number of positive sections, and longevity and intensity of surveillance in the surrounding area. For counties within the CWD Management Zone in which CWD has not been detected, the ranking system will consider distance to the nearest positive, characteristics of the nearest positive(s), and surveillance history.

One of the most critical applications of mandatory sampling is to guide post-season targeted removals, arguably the most effective direct management tool for slowing spread of CWD. Therefore, priority for mandatory sampling will be given to counties where information is most needed to make decisions about targeted removals. Status of CWD in a county (Initial CWD Detection, Pre-establishment CWD Infection, Endemic CWD Infection) will also be a critical factor in determining where mandatory sampling is conducted each year. Mandatory sampling will be prioritized where the information is most needed to direct targeted removals. If targeted removals will not be conducted in an area due to classification as an Endemic CWD Infection, mandatory sampling will not be conducted annually. For counties where mandatory sampling does not occur annually, sampling goals will be set to detect prevalence increases at a desirable level of precision. These sampling goals will be incorporated into the annual CWD Operational Plan as described in the Statewide CWD Surveillance and Monitoring section of this Plan, and sampling goals will be met using the same techniques.

CWD MANAGEMENT AND PREVENTION

Research and experience show that without active management intervention, CWD infection rates and geographic distribution increase and reach a point of near exponential growth and

ultimately high disease prevalence. Negative population impacts have been documented in other states with high prevalence rates, and the occurrence of CWD can influence and alter hunter behavior and attitudes. The Conservation Department is committed to slowing the spread of CWD and minimizing the negative impacts of the disease on the state's deer population, economy, and the deer hunting culture. Management intervention is likely to be most effective when disease prevalence rates are low, and prion loads in the environment are minimal. Unfortunately, there is no single action that can successfully suppress CWD spread. Rather, a multifaceted risk reduction approach is likely to be most effective. This approach requires identification of key risk factors for CWD spread and the application of specific actions or interventions to reduce each risk. In terms of its management approach, MDC will target the following key risk factors for CWD spread:

- Anthropogenic movement of cervids:
 - Carcass transportation and improper carcass disposal,
 - Transportation of live deer.
- Natural cervid movement, behavior, and population characteristics:
 - Dispersal,
 - Deer density,
 - Male age-structure.
- Environmental transmission:
 - Unnatural congregation (e.g., feeding wildlife).
- Transmission rates:
 - Number of infected deer in the population.

Broadscale Regulations within the CWD Management Zone

The following regulation changes will be recommended in all CWD Management Zone counties regardless of whether a county has a status of Initial CWD Detection, Pre-establishment CWD Infection, or Endemic CWD Infection. These regulations are designed to decrease priority known risks associated with CWD transmission.

1. Removal of the antler-point restriction (APR)

The APR protects most yearling male deer from harvest in Missouri, the sex-age class most likely to disperse the greatest distances and potentially spread CWD. Although the APR is a popular regulation in the counties where it is implemented, this harvest restriction directly conflicts with CWD management goals by protecting a high-risk segment of the deer population from harvest. As such, it is not an appropriate regulation to have in place within the CWD Management Zone and will be proposed to be rescinded when counties enter the CWD Management Zone.

2. Increase firearms antlerless deer hunting permits

Although CWD is not an entirely density-dependent disease, density influences contact rates and therefore, density likely has some influence on CWD spread. Increases in antlerless harvest are intended to avoid undesirable increases in deer numbers within the CWD Management Zone.

3. Ban use of feed and minerals intended to attract deer

These practices encourage congregation of deer and increase both direct and indirect contact rates. As such, prohibiting feed and minerals to be placed for deer year-round within the CWD Management Zone reduces the risk of spreading CWD.

4. Implement intrastate carcass transportation restrictions

Transportation of high-risk deer parts out of the county of harvest, if harvested in the CWD Management Zone, is prohibited unless delivered (within 48 hours) to a licensed meat processor, licensed taxidermist, or if a deer head is delivered to an MDC approved CWD sampling station. As a complimentary regulation to the carcass transportation restrictions, all licensed taxidermists and meat processors must dispose of unused cervid parts in a permitted landfill or transfer station except for hides from which all excess tissue has been removed.

Future Considerations for Regulations within the CWD Management Zone

The continued detection of CWD in new areas of Missouri, expanding distribution in both Missouri and some neighboring states, and slowly increasing sample prevalence rates in some parts of Missouri necessitate the need to consider additional harvest management regulations to manage CWD. As such, changes to harvest regulations are being considered to increase deer harvest within the CWD Management Zone. Potential changes to harvest regulations include creation of additional season portions, increasing bag-limits, and incentivizing harvest. In the future, additional changes to hunting regulations may be needed to augment the targeted removal program or to serve as an alternative where targeted removals are no longer conducted in an area due to high disease infection rates and/or wide spatial distribution. The ongoing CWD modeling project will involve simulating the effects of various deer densities on CWD prevalence rates and spread. As such, results from the project will be helpful in developing deer management objectives within the CWD Management Zone.

Localized Management within CWD Core Areas

Designation of a CWD Core Area

In an area classified as an Initial CWD Detection or a Pre-establishment CWD Infection, a CWD Core Area will be designated. The designation of CWD Core Areas has been a key tenet of

Missouri's CWD response since detecting the disease in the state. A CWD Core Area will be defined by establishing an approximately two square-mile (two PLSS section) buffer around each PLSS section where CWD is detected. Within CWD Core Areas, localized management intervention (targeted removals and CWD Management Permits) will be applied, and increased landowner engagement and communication will occur. CWD Core Areas remain fluid, and boundaries may change as new positives are detected. New CWD Core Areas may be defined during any point of a surveillance year. Boundaries may also vary among CWD Core Areas depending on the local landscape and biologic features.

Where CWD is limited in prevalence and/or distribution, focalized increased removal of deer has shown successful in slowing or stabilizing CWD growth rates. Because selective removal of CWD-positive deer is not possible, increasing removals of deer in areas where CWD is most likely to be found increases the likelihood of additional infected animals being removed from the population. Minimizing the number of infected individuals also helps to reduce the amount of environmental contamination. In addition to removing CWD-positive deer, lowering deer density in localized areas where CWD has been detected is also likely to further slow spread of the disease, both helping to maintain low disease prevalence in these areas and minimizing risk to surrounding, unaffected, deer populations.

Post-Season Targeted Removals

After the close of the deer hunting season, MDC staff works with landowners in CWD Core Areas to lethally remove deer by conducting post-season targeted removals. Targeted removals occur between January 16 and March 15. During targeted removals, landowners that choose to participate can receive authorization to remove deer or allow MDC staff to remove deer. Baiting and the use of lights may be authorized to increase efficiency of deer removal. Meat from deer in which CWD is not detected is returned to the landowner or donated to the Share-the-Harvest Program based on the landowner's wishes.

Specific locations in which to focus targeted removals within a CWD Core Area are prioritized based on surveillance history, local variables, and resource availability. Typically, targeted removals will continue within a CWD Core Area for a minimum of three years if no additional CWD-positive deer are detected. However, Science Branch staff may recommend ceasing removals sooner or extending them longer depending on surveillance history, number of CWD-positive deer detected, landowner participation levels, and local variables such as deer densities, and other site-specific factors. Results from the previously mentioned CWD modeling project will be critically important to guiding future targeted removal efforts, and Science Branch staff will continue to work closely with regional staff to develop guidelines and goals to determine location and intensity of targeted removals.

Objectives of the CWD modeling project include identifying factors that will help to maximize effectiveness of targeted removals and identifying trigger points to help guide targeted removal efforts where they are likely to be the most successful. Results of the project will provide explicit trigger points that will help to determine where targeted removals should occur and where the spatial extent or infection rates of disease are great enough that removal efforts are no longer likely to be effective (i.e., Endemic CWD Infection areas). As such, as these results become available, they will be incorporated into this Plan and be used to guide targeted removals efforts beginning in 2023.

In addition to the modeling project, MDC will be conducting a survey of landowners in CWD Core Areas to gain a greater understanding of the motivations and barriers to participating in post-season targeted removal efforts. As part of this survey, MDC will explore potential ways to incentivize landowners to participate in the program. Information gained from this research project will be incorporated into future CWD Operational Plans and targeted removal planning efforts. For additional information about these research projects, see the CWD Research section of this document.

CWD Management Permits

Landowners with five or more acres within a CWD Core Area are eligible to receive CWD Management Permits. Each CWD Management Permit may be used to harvest a deer of either sex by any method that is legal at the time of harvest. Permits may be issued to a landowner, or the landowner may select other hunters to allocate any portion of the permits. As an incentive to harvest deer and to have them tested for CWD, deer processing reimbursement is offered for any deer harvested using a CWD Management Permit if the deer is tested for CWD. A valid resident, nonresident, or landowner deer hunting permit is required as a prerequisite to obtain CWD Management Permits. CWD Management Permits are made available during the deer season after the designation of a CWD Core Area.

Providing liberal harvest opportunities within CWD Core Areas will continue to be an important component of CWD management in Missouri. At the time of revising this Plan, however, CWD Management Permits, in their current form, have only been in use for two years. Given the rapid expansion of CWD Core Areas since development of these permits and the associated data complexity of maintaining the underlining landowner database, there have been numerous challenges to the program. Moreover, some hunters have expressed concern about the complexity of the process to obtain these permits. As such Wildlife Health and Cervid Program staff will continue to evaluate the effectiveness, implementation, and sustainability of the CWD Management Permit program to ensure that it is meeting disease management objectives.

CWD COMMUNICATION

Clearly and effectively communicating with stakeholders about CWD and MDC's approach to CWD surveillance and management is critical. MDC has used a combination of in-person and multimedia information delivery when communicating about CWD and will continue to work with staff in the Communications Branch to evaluate the most effective way of keeping stakeholders informed about the disease. The Department's CWD Communication Team has, and will continue to, lead development of an annual CWD Communication Strategy to ensure transparency with staff, stakeholders, and the public. The Department will continue to make the public aware of opportunities to have their deer tested for CWD. MDC will produce an annual CWD Report to summarize findings from the previous disease surveillance year.

At a more local level, timely communication with landowners where CWD is newly identified is important to build trust and accountability. When CWD is detected in a new area, MDC staff will notify landowners in a timely fashion and Department staff will consider holding a public meeting. Ongoing communication in existing CWD Core Areas is equally important, and local staff will work with the CWD Communications Team to plan outreach and communication efforts as needed. Communication will be especially critical if an area of the state is classified as having an Endemic CWD Infection.

Results of a recently conducted research project will help MDC gain a better understanding of the motivations and barriers for landowners participating in post-season targeted removal efforts. This project will also help to inform future communication efforts about CWD with stakeholders and serve as a springboard for development of a comprehensive marketing strategy. Cervid and Wildlife Health Program staff will work with Communications Branch staff to use project results to ensure the effectiveness of future communication about CWD. Project results will be used to help inform communication with landowners, particularly in CWD Core Areas where post-season targeted removals occur, and to assess public opinions about CWD and MDC's approach to CWD management.

CWD RESEARCH

It is important that MDC staff continue to engage in applied CWD research and its epidemiology to support CWD management. MDC's State Wildlife Veterinarian, Wildlife Health Program staff, and Cervid Program staff are currently involved with several research projects, a summary of which can be found below. MDC staff will continue to identify opportunities for internal and external funding to conduct research and will seek to partner with other state and federal agencies, NGOs, and universities as appropriate to increase knowledge about the disease and how to manage it most effectively.

Evaluation of CWD Sample Prevalence and Targeted Removal Efficacy

The Department's biometricians, Wildlife Health Program, and Cervid Program have initiated a research project to analyze CWD surveillance and management data, focusing initially on northcentral Missouri. Using a Bayesian modeling framework, they are examining sample prevalence and spatial distribution of CWD over time and developing techniques to evaluate the potential impacts of targeted removals. These efforts will aid in developing a statistical framework for presenting disease trends and will help assess the impacts of targeted removals on CWD prevalence rates and spread.

Prion Strain-typing Project

This ongoing research project is a collaborative effort involving Colorado State University (CSU) and several state fish and wildlife agencies. Dr. Mark Zabel at CSU is the project principal investigator. During this project, MDC provided CWD-positive tissue samples to examine the diversity of potential CWD strain-types at various geographic scales. There are three phases to characterizing prion strain-types, including bio-chemical analysis, bioassay, and pathophysiology. As of May 2022, phases one and two of the project are complete and phase three is nearing completion. This research project has the potential to identify unique strains of CWD, characterize associated differences in disease dynamics, and provide insight to CWD spread on a large scale.

Development and Application of MEMS-Based Biosensor and RT-QuIC Assay for the Detection of Chronic Wasting Disease in Ante- and Post-Mortem Samples

This ongoing collaborative research project between MDC and the University of Missouri College of Engineering and Veterinary Medicine is being led by Drs. Michael Zhang, Mahmoud Almasri, and Shuping Zhang. This research project involves developing a Nano technology (MEMS microelectromechanical system) to detect CWD. This technology, which has been used to detect various pathogens and toxins in animal and environmental samples, holds promise for being able to detect smaller quantities of pathologic prion than other methods. As such, it could allow detection of CWD at earlier stages of disease.

Identifying and Understanding Landowner Motivations and Barriers to Participating in MDC Chronic Wasting Disease Targeted Removal Program

This ongoing research project has two objectives: 1) Identify and assess the barriers and motivations that influence landowner participation in targeted removals, and 2) Obtain information to help recruit landowners and to retain their participation in targeted removals. During the project, MDC collaborated with DJ Case & Associates to conduct 12 focus group meetings with landowners in a subset of CWD Core Areas. Information obtained from the focus

group meetings will be used to design a survey that will be mailed to landowners in all CWD Core Areas to quantitatively assess landowner opinions of targeted removals and to gain a greater understanding of their opinions about CWD and CWD management.

Modeling the Effects and Risks of Common Harvest Strategies and Human Practices to Promote Effective Management of Chronic Wasting Disease

This ongoing research project is a collaborative effort between MDC and researchers at Emory University and the University of Montana. Objectives of the project are to: 1) Evaluate the effects of targeted removals on CWD prevalence rates in northern Missouri, 2) Evaluate factors that would result in maximum effectiveness of the targeted removal strategy, 3) Identify trigger points to guide targeted removal efforts to help allocate limited resources where they are likely to be most successful, and 4) Identify alternative harvest strategies to implement when targeted removal efforts are no longer likely to be successful due to high CWD prevalence rates. Results from the project will be used to prioritize targeted removal efforts and determine when targeted removal efforts should cease in an area based on the evaluated factors. Project results will also help to determine how the disease surveillance approach should change based on thresholds of prevalence rates and spatial distribution.

FREE-RANGING ELK IN MISSOURI

Chronic wasting disease surveillance within Missouri's restored elk population is important. Any sick elk that dies or is euthanized, and any elk found dead and in good enough condition, is sampled and tested for CWD. Testing of hunter-harvested elk is strongly encouraged, and MDC staff engage with successful hunters in an attempt to obtain CWD samples from all harvested animals. Instances of free-ranging elk located outside of the elk restoration zone are evaluated on a case-by-case basis, and any animals that are removed are tested for CWD. Chronic wasting disease surveillance of white-tailed deer in and around the elk restoration zone is also important. One source of increased CWD surveillance in this area has been voluntary testing of deer from managed deer hunts held at Peck Ranch Conservation Area. Science Branch staff will continue to coordinate with staff at Peck Ranch to help facilitate this important sampling effort.

CONFINED CERVIDS IN MISSOURI

Confined cervid regulations were approved in Missouri in 2014, but implementation was delayed by litigation. These regulations banned inter-state importation of live cervids, increased fencing standards, and added CWD testing and record keeping requirements. To increase testing compliance and further reduce risks of CWD spread, MDC has since worked closely with the Missouri Department of Agriculture (MDA) and industry members to revise the regulations. Effective August 2021, new testing and reporting requirements and a new movement certification process were instituted. These regulations are detailed in 3 CSR 10-9.354 of the

Wildlife Code of Missouri. Department staff will continue to work with MDA staff and representatives from the confined cervid industry to ensure compliance with these regulations to protect the health of wild and confined cervids in Missouri.

HUNTER SERVICE TESTING

To date, there have been no reported cases of CWD infection in humans; however, laboratory studies suggest that some non-human primates are susceptible to CWD and therefore the risks to humans may not be zero. MDC is not a public health authority but has partnered with the Missouri Department of Health and Senior Services and has encouraged hunters to follow recommendations of state and federal public health authorities. The Centers for Disease Control and Prevention (CDC) recommends that hunters in areas known to have CWD test their deer and wait for a not-detected result before consuming any parts of the deer. The Conservation Department recognizes the importance of providing hunters with information to make informed decisions and meeting the demands of hunters seeking testing of their deer for CWD. In recent years, hunter demand for testing opportunities has increased. As such, additional CWD sampling efforts or programs may be implemented to meet this demand.

Share the Harvest CWD Testing Program

The Share the Harvest Program is jointly managed by MDC and the Conservation Federation of Missouri, and MDC is responsible for working with meat processors to execute the testing requirements of the program. In 2017, the Missouri Department of Health and Senior Services, MDC, and the Missouri Department of Agriculture jointly decided to require testing of all deer donated to the Share the Harvest Program if harvested within the CWD Management Zone. The decision was made to ensure that donated venison follows the recommendations specified by the CDC, specifically that deer harvested in areas known to have CWD are tested before consumption. The primary purpose of the Share the Harvest CWD Testing Program rests in maintaining public trust and Department accountability by ensuring that meat harvested within the CWD Management Zone, and donated to Missourians in need, follows public health guidelines.

Freezer Drop-off CWD Testing Program

In 2020, a freezer drop-off program was initiated in CWD Management Zone counties, providing self-service locations where hunters can leave a deer head for CWD sampling. The number of deer heads left for testing as part of this program during the first year was relatively low (approximately 300), but many hunters shared their appreciation with MDC staff for the availability of this testing opportunity. In 2021, the number of deer heads collected by this program more than doubled. Although hunters have continued to express appreciation for the program, there were concerns with results turnaround time by some hunters. How best to balance

staff time to monitor the freezers during deer season and hunter demands for fast test results represents a challenge that needs attention. Ensuring data integrity during this self-service testing opportunity is important and Wildlife Health Program staff will continue to evaluate the best way to obtain needed information from hunters without making the process overly burdensome for them. Success of the program will continue to be evaluated over time, and the program may be expanded in the future if warranted.

Other Hunter Service Testing Opportunities

To date, hunter service testing opportunities have been prioritized within the CWD Management Zone, allowing hunters with the greatest likelihood of harvesting a CWD-positive deer options to have their deer sampled. In addition to the Freezer Head-drop CWD Testing Program, MDC has partnered with taxidermists within the CWD Management Zone who agree to publicly advertise their business as a location for CWD sampling. For counties outside of the CWD Management Zone, MDC will accept any deer for testing at a hunter's request, but opportunities in counties outside of the CWD Management Zone are limited to MDC Regional offices. Science Branch staff will continue to assess hunter-demand for testing and will consider expanding opportunities if and where needed.

APPENDIX A. History of CWD in Missouri

Since MDC began routine CWD surveillance in 2002, over 210,000 deer have been tested in the state (Figure 1). Nearly 33,000 free-ranging white-tailed deer were tested throughout the state prior to the first CWD detection in confined deer facilities in Linn and Macon counties in 2010 and 2011, and prior to the first free-ranging confirmations in Macon County in 2012. This broad, statewide surveillance effort lends confidence that CWD was detected when it was relatively newly introduced to the state and has not always been in Missouri. Early detection, before the disease was widely distributed or at high prevalence, prompted MDC to respond aggressively to the initial detection.

The first CWD Surveillance and Management Plan in Missouri, which was implemented in 2012, called for:

- Continued testing of deer throughout the state with the cooperation of taxidermists to collect samples on a rotational basis.
- Creation of a CWD Management Zone consisting of counties within 25 miles of the CWD-positive detections.
- Regulation changes within the CWD Management Zone, including the prohibition of feed and minerals, rescindment of the antler-point restriction, and an increase in firearms antlerless permits.
- Increased CWD testing within the CWD Management Zone.
- Creation of a CWD Core Area encompassing a one square-mile buffer around the CWD-positive locations.
- Post-season targeted removals within the CWD Core Area.

Since 2012, continued expansion of CWD in Missouri has been documented. As of May 2022, CWD has been detected in 292 deer in 22 Missouri counties. Although the continued expansion of CWD in the state is concerning, surveillance data suggests that the disease remains relatively rare, and the vast majority of deer in Missouri remain unaffected. Since the initial CWD Surveillance and Management Plan was developed, MDC has adapted to new realities and knowledge over time by implementing several significant alterations to its surveillance and management approach.

- In 2015, CWD was detected for the first time outside of north-central Missouri in Cole and Franklin counties prompting the introduction of a mandatory sampling regulation that was implemented in 2016. The regulation required hunters in designated CWD Management Zone counties to bring their deer to a CWD sampling station if harvested on opening weekend of the November portion of firearms deer season. The purpose of this

regulation was to increase the probability of detecting new spread of the disease and improve understanding of disease distribution.

- In 2019, the CWD Management Zone was reduced in size to include only counties within 10 miles of a CWD-positive detection. This change was made because data from a study conducted by the University of Missouri and MDC found that more than 90% of deer dispersed less than ten miles.
- In 2020, intrastate deer carcass transportation restrictions were established for deer harvested in the CWD Management Zone, and the interstate carcass transportation restrictions that initially went into effect in 2010 were modified to prohibit entire hunter-harvested cervid carcasses from entering the state. Also, in 2020, deer disposal requirements were established statewide for licensed meat processors and taxidermists.
- In 2021, new testing and reporting requirements went into effect for confined cervid facilities, and a new movement certification process was instated.

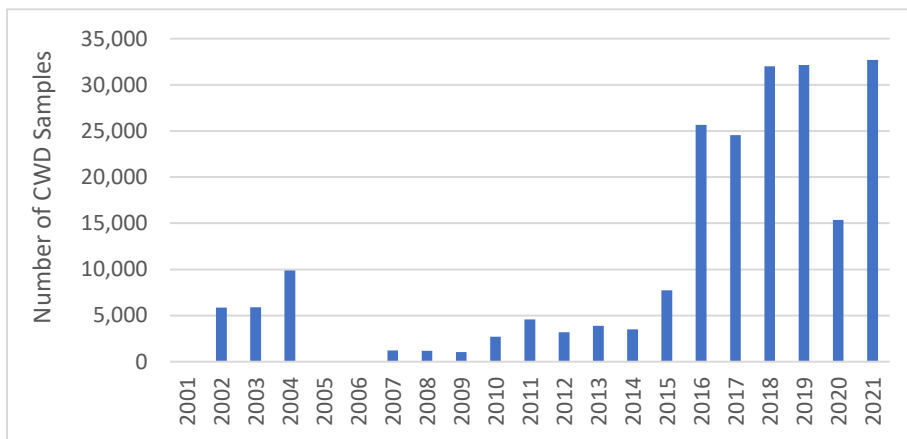


Figure 1. Total annual number of samples from free-ranging deer tested for chronic wasting disease in Missouri, 2001–2021.

APPENDIX B. Evaluation of CWD Surveillance and Management in Missouri

To direct CWD response in a manner that is most likely to best serve the resource, constituents, and MDC staff, it is important to thoroughly evaluate surveillance and management efforts to date and identify priority deficiencies that need to be addressed. This section summarizes results of an evaluation conducted during the process of revising the CWD Surveillance and Management Plan and highlights important areas for future consideration.

Current Status of CWD in Missouri

When CWD was first confirmed in free-ranging deer in north-central Missouri in 2012, the known distribution was a single CWD cluster with low sample prevalence and limited geographic distribution. As of May 2022, 292 CWD-positive deer in 22 counties have been detected in Missouri. Based on the surveillance history, there is little doubt that the distribution of CWD has expanded substantially in Missouri (Figures 1 and 2). Seemingly unique to Missouri, CWD is known to exist in numerous areas of the state at low sample prevalence but at varying geographic distribution (Figure 2). This surveillance history and pattern of CWD distribution suggests that CWD remains relatively rare in Missouri, and it is likely that there have been numerous introductions of the disease into various parts of the state rather than disease spread from a single introduction.

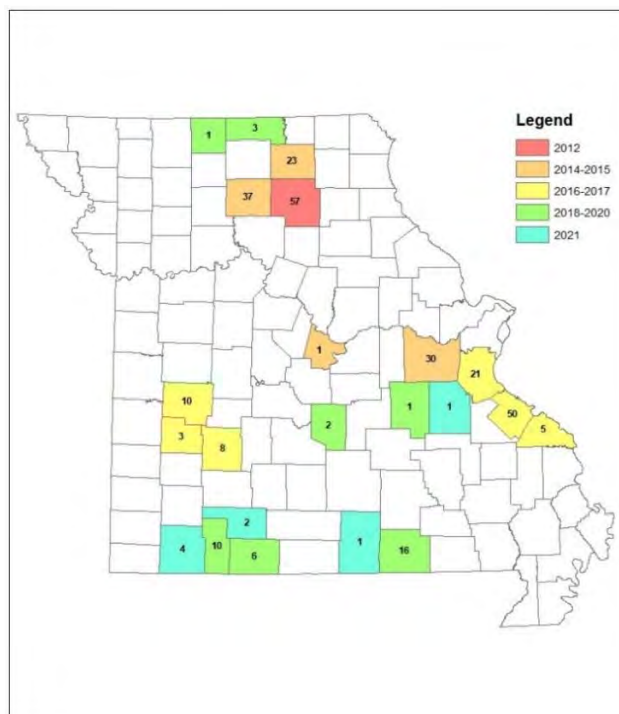


Figure 1. First year of CWD detection and total number of CWD positive detections in Missouri as of May 2022.

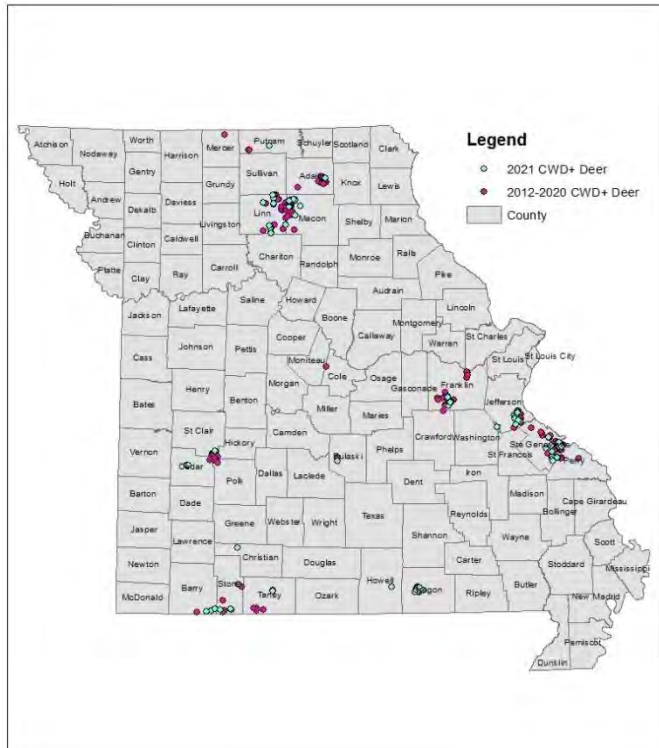


Figure 2. Cumulative distribution of CWD positive detections in Missouri as of May 2022.

In some areas of the state, like Ste. Genevieve County (Figure 3), sample prevalence of CWD appears to be increasing. However, in other areas of the state, like Macon County, where CWD management intervention has been ongoing for over ten years, CWD sample prevalence remains low (Figure 4).

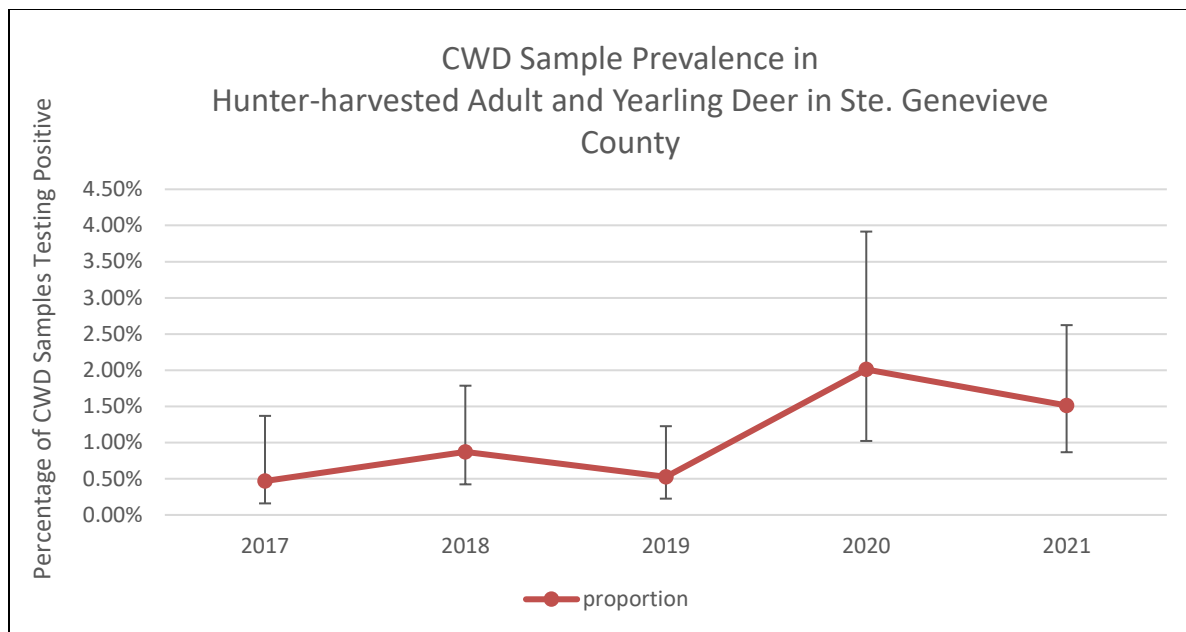


Figure 3. Sample prevalence of CWD in Ste. Genevieve County, Missouri, 2017-2021.

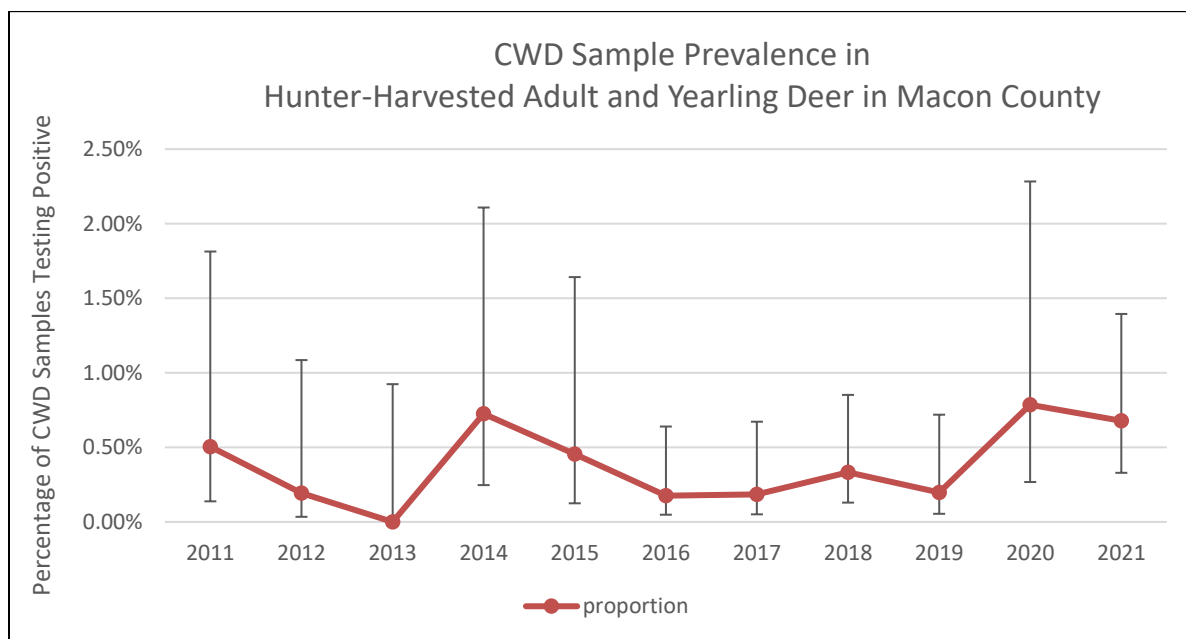


Figure 4. Sample prevalence of CWD in Macon County, Missouri, 2011-2021.

Of the 22 CWD-positive counties, five have had a single detection despite extensive surveillance. Moreover, in 2021, the percentage of yearling and adult hunter-harvested deer that tested positive for CWD was less than one percent in all but three counties; in those counties, sample prevalence was only slightly greater than one percent (Table 1). Low sample prevalence suggests that robust surveillance efforts have helped to detect the disease early after introduction, and that management intervention is helping limit the number of CWD-positive deer on the landscape.

Table 1. Number of CWD samples from adult and yearling deer harvested in Missouri during 2021 and the percentage of samples that tested positive for CWD.

County	Number of Samples	% CWD+ Yearling and Adult Hunter-harvested Deer
Adair	848	0.24%
Barry*	519	0.76%
Cedar	867	0.23%
Christian*	623	0.32%
Franklin	1973	0.30%
Howell*	1295	0.08%
Jefferson	1240	0.97%
Linn	1115	1.08%
Macon	1289	0.78%
Oregon	1071	0.56%
Perry	787	0.25%
Pulaski	713	0.14%
Putnam	406	0.25%
St. Clair	1124	0.09%
Ste. Genevieve	1105	1.36%
Stone	502	1.20%
Taney	634	0.32%
Washington*	650	0.15%

*Counties in which the first CWD-positive detection was in 2021.

Early Detection

One of the seemingly greatest successes of CWD surveillance in Missouri to date has been the continued detection of CWD before the disease has become widely established. Detecting CWD early after introduction allows implementation of management strategies at a phase of the disease where it is most likely to slow transmission rates. Through a combination of surveillance techniques, particularly mandatory sampling within the CWD Management Zone and statewide taxidermist partnerships, the distribution of the disease at the time of detection has been limited thus far. Moreover, county-level sample prevalence rates in areas where the disease has been newly detected have been low. For instance, in 2021, the sample prevalence rates of yearling and adult hunter-harvested deer in the four counties where the disease was detected for the first time were 0.76% (Barry County), 0.32% (Christian County), 0.15% (Washington), and 0.08% (Howell County). To date, there has been roughly an equal number of new areas of CWD detections in Missouri that have been identified from mandatory sampling as compared to statewide taxidermist sampling. This experience lends support for the currently implemented surveillance strategy and suggests that a multi-tiered approach to CWD surveillance is likely to continue to be most successful.

Public and Partner Support

Management of CWD is a cooperative endeavor and must have meaningful buy-in and participation from hunters, business partners (especially taxidermists and meat processors), state and federal partners, and others to be successful. The Department's partner sampling program is evidence of broad support from key partners. In 2021, approximately 120 taxidermists and 20 meat processors collected CWD samples as part of Missouri's CWD surveillance strategy. These partners not only contribute critical CWD surveillance data but also help meet hunter-service testing demands, address public health concerns (e.g., Share the Harvest CWD Testing Program) and act as CWD-response ambassadors or influencers.

Critically, the support of hunters underlies the likelihood of success in CWD management. Without the consent and participation from hunters and landowners, CWD surveillance and management efforts are likely to fail. Thankfully, the majority of Missouri hunters are concerned about CWD and support MDC's management approach. In 2021, 83% of hunters surveyed indicated that they support MDC's efforts to limit CWD. On the same survey, over 88% of respondents stated they were concerned about the potential for CWD to reduce the health of the deer population in the state.

Current Challenges

CWD is a complicated disease and therefore remains a complex subject to understand and subsequently design meaningful intervention tools. As such, there will always be gaps in

knowledge or priority social issues that are integral to disease management. This section explores some of the significant challenges when managing CWD in Missouri.

- Carcass transportation and disposal
 - In 2020, MDC implemented new intra-state carcass transportation regulations within the CWD Management Zone and modified existing interstate carcass transportation regulations. Given the considerable change in behavior that these regulations require from hunters, it would be beneficial to assess hunters' understanding and compliance with the regulations and determine if or how the regulations have affected hunter effort within the CWD Management Zone.
 - There are increasing reports of landfills and transfer stations rejecting cervid butcher waste in some areas of the state. A statewide assessment is needed to gauge the extent of the deficiency, identify significant gaps in landfill and transfer station availability, and assess the disposal requirement for taxidermists and meat processors.
- Availability of meat processors to process hunter-harvested deer
 - Meat processors are critical partners in MDC's CWD surveillance strategy and their ability to process harvested deer likely has a positive effect on deer hunter numbers. Several issues related to meat processing have been recognized and necessitate further consideration and investigation. These include a general shortage of meat processors that are willing to process deer and a shortage of meat processors in CWD Management Zone counties that are enrolled in the Share the Harvest CWD Testing Program. Because many hunters rely on these businesses to process their deer, shortages may be affecting the number of hunters that pursue deer and could reduce the willingness of some hunters to increase the number of deer they harvest. Because all deer donated to the Share the Harvest Program that are harvested in the CWD Management Zone must be tested for CWD, having enough meat processors within the CWD Management Zone is critical. Because deer numbers are increasing throughout much of the state, availability of Share the Harvest processors is important because it may encourage hunters to harvest additional deer that are needed to meet deer management goals.
- Gaps in knowledge about CWD
 - There remain considerable gaps in the understanding of the fate of prions in the environment and the role environmental transmission plays in the spread of CWD.
 - Potential routes of CWD transmission have been identified but specific, complex, epidemiological understanding is limited.
 - There is evidence that CWD prions are changing over time. As the pathogen evolves, there is a possibility that dynamics of the disease may also evolve and that the risks of non-cervid spill over events may increase. Prion strain-typing studies may help address some of these uncertainties.

- Testing technology
 - Current CWD testing technology and related infrastructure means that results turnaround time varies greatly and is too slow to address concerns some hunters may have about processing and consuming a deer with unknown disease status.
 - Current technology relies on the collection of retropharyngeal lymph nodes and/or brainstem (obex) and does not allow for ready testing of environmental samples to determine CWD status, making tracking of environmental fate of CWD nearly impossible.
- Hunter and landowner participation in CWD management efforts
 - There has been a declining trend in the number of landowners granting access to MDC to conduct targeted removals in some CWD Core Areas which jeopardizes the effectiveness of these efforts.
 - There is a reduced willingness of some hunters to harvest antlerless deer and an increased preference for harvesting antlered deer.
 - Deer hunter numbers are declining in Missouri, which will make management of CWD and the deer population increasingly challenging.